

PATENT COOPERATION TREATY PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)



Applicant's or agent's file reference 38098WOP00	FOR FURTHER ACTION See Form PCT/IPEA/416	
International application No. PCT/AU2004/000315	International filing date (day/month/year) 16 March 2004	Priority date (day/month/year) 17 March 2003
International Patent Classification (IPC) or national classification and IPC Int. Cl. ⁷ B03D 1/16, 1/18, 1/20, 1/22, B01F 7/22		
Applicant OUTOKUMPU OYJ et al		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of **3** sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
 - a. ☒ (sent to the applicant and to the International Bureau) a total of **6** sheets, as follows:

☒ sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
 - b. ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) containing a sequence listing and/or table related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:
- | | | |
|-------------------------------------|--------------|---|
| <input checked="" type="checkbox"/> | Box No. I | Basis of the report |
| <input type="checkbox"/> | Box No. II | Priority |
| <input type="checkbox"/> | Box No. III | Non-establishment of opinion with regard to novelty, inventive step and industrial applicability |
| <input type="checkbox"/> | Box No. IV | Lack of unity of invention |
| <input checked="" type="checkbox"/> | Box No. V | Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement |
| <input type="checkbox"/> | Box No. VI | Certain documents cited |
| <input type="checkbox"/> | Box No. VII | Certain defects in the international application |
| <input type="checkbox"/> | Box No. VIII | Certain observations on the international application |

Date of submission of the demand 4 January 2005	Date of completion of the report 27 April 2005
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer DAVID K. BELL Telephone No. (02) 6283 2309

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/AU2004/000315

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ This report is based on translations from the original language into the following language which is the language of a translation furnished for the purposes of:

☐ international search (under Rules 12.3 and 23.1 (b))

☐ publication of the international application (under Rule 12.4)

☐ International preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

☐ the international application as originally filed/furnished

☒ the description:

pages **1, 3 to 7** as originally filed/furnished

pages* **2a** received by this Authority on **4 January 2005** with the letter of 4 January 2005

pages* **2** received by this Authority on **14 April 2005** with the letter of 14 April 2005

☒ the claims:

pages as originally filed/furnished

pages* as amended (together with any statement) under Article 19

pages* **8 to 11** received by this Authority on **14 April 2005** with the letter of 14 April 2005

pages* received by this Authority on with the letter of

☒ the drawings:

pages **1/3 to 3/3** as originally filed/furnished

pages* received by this Authority on with the letter of

pages* received by this Authority on with the letter of

☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages

☐ the claims, Nos.

☐ the drawings, sheets/figs

☐ the sequence listing (*specify*):

☐ any table(s) related to the sequence listing (*specify*):

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

☐ the description, pages

☐ the claims, Nos.

☐ the drawings, sheets/figs

☐ the sequence listing (*specify*):

☐ any table(s) related to the sequence listing (*specify*):

* If item 4 applies, some or all of those sheets may be marked "superseded."

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**1. Statement**

Novelty (N)	Claims 1 to 39	YES
	Claims	NO
Inventive step (IS)	Claims 1 to 39	YES
	Claims	NO
Industrial applicability (IA)	Claims 1 to 39	YES
	Claims	NO

2. Citations and explanations (Rule 70.7)

D1 = US 6109449

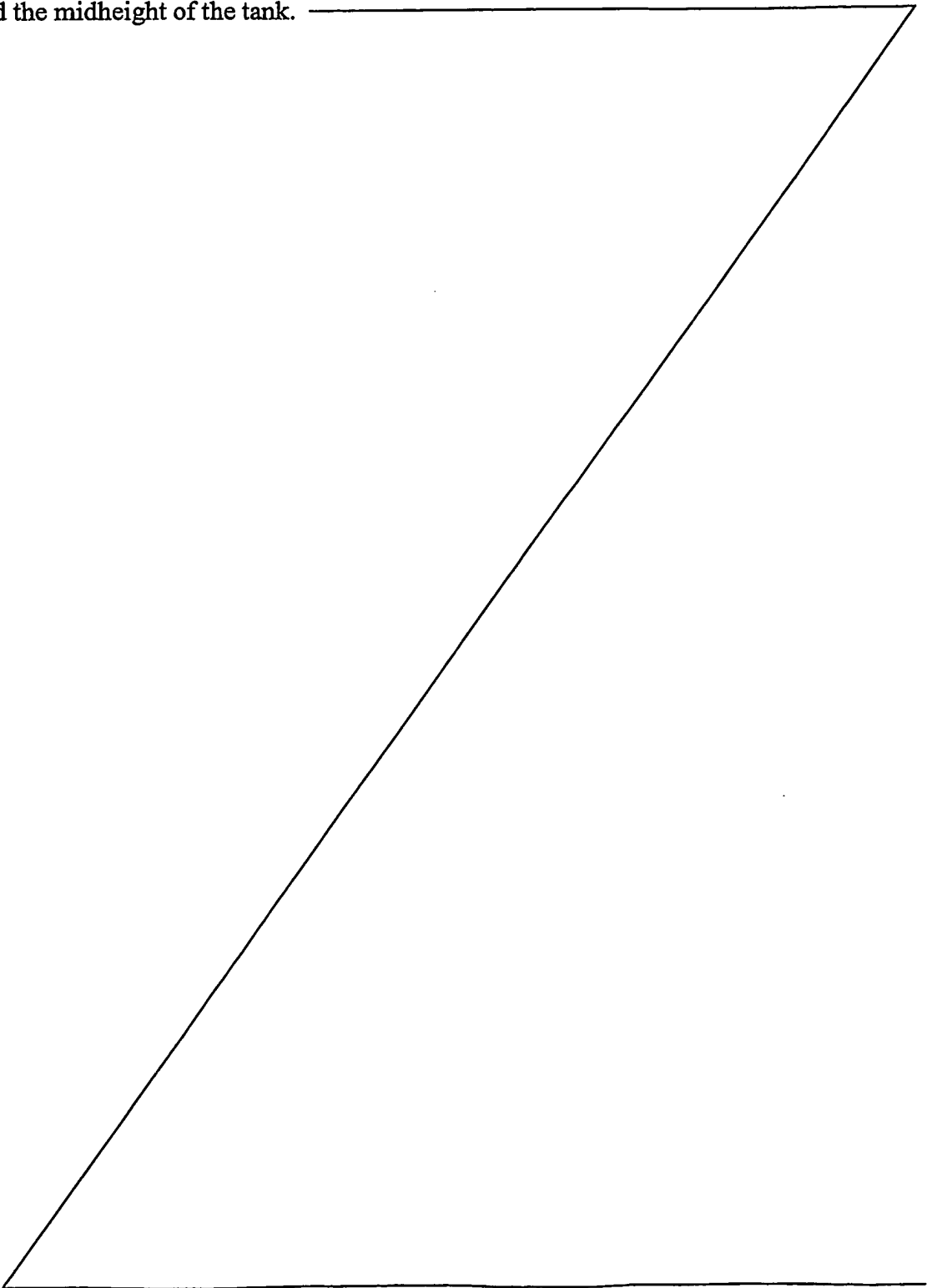
D2 = AU 1999/24989

The document D1 (US 6109449) discloses a mixing system to be used in a flotation process in which an auxiliary agitator is used to supplement an axial flow induced by a primary agitator rotor and the auxiliary agitator has a connection means for connection to the drive shaft between the drive means and the primary agitator rotor. Amended claim 1 of the present specification defines a similar mixing system; however the primary agitator is adapted to induce radial fluid flow, while the auxiliary agitation blade disposed above the primary rotor is adapted to induce axial fluid flow.

None of the cited documents either singly, nor in obvious combination, disclose or fairly suggest the invention as defined in the present claims. The claimed invention is therefore novel, has an inventive step and is industrially applicable.

- 2a -

[AMENDED PAGE]

Preferably, the blade is releasably connected to the shaft to allow its position along the shaft to be adjusted. However, the blade is preferably connected to the shaft at around the midheight of the tank. 

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[AMENDED PAGE]

As flotation devices increase in size, the agitation input energy must increase proportionally. Moreover, for a large flotation device to maintain efficiency, it must be capable of achieving a similar flotation kinetic rate as that achieved by a group of smaller cells of the same total volume.

5 In recent years, the size of flotation devices has increased, primarily for economic reasons. However, the design of such devices has remained relatively unchanged. Accordingly, for the reasons mentioned above, these large flotation devices are often not optimised in terms of flotation efficiency.

10 It is therefore an object of the present invention to overcome or substantially ameliorate one or more of the disadvantages of the prior art, or at least to provide a useful alternative.

SUMMARY OF THE INVENTION

Accordingly, a first aspect of the invention provides an auxiliary agitator for a flotation device of the type having a tank, a primary agitator including a primary rotor
15 adapted to induce radial fluid flow, drive means, and a drive shaft disposed intermediate the drive means and the primary rotor, the auxiliary agitator including:

an auxiliary agitation blade disposed above the primary rotor and adapted, in use, to induce axial fluid flow in a downward direction so as to supplement flow induced in the tank by the primary rotor; and

20 connecting means for connecting the auxiliary agitation blade to the drive shaft for conjoined rotation with the primary rotor.

Preferably, the angle of incidence is constant along the length of the blade, as in an axial impeller, at between 15 degrees and around 75 degrees with respect to the direction of travel of the blade. Alternatively, the angle of incidence varies along the length of the
25 blade, as in a propeller. In another embodiment, the pitch of the blade is adjustable depending on specific system parameters, such as slurry density, slurry viscosity or flow characteristics within the tank.

Preferably, the blade includes a substantially straight leading edge. However, in alternative embodiments, the leading edge may be curved.

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[AMENDED PAGE]

CLAIMS

1. An auxiliary agitator for a flotation device of the type having a tank, a primary agitator including a primary rotor adapted to induce radial fluid flow, drive means, and a drive shaft disposed intermediate the drive means and the primary rotor, the auxiliary agitator including:
an auxiliary agitation blade disposed above the primary rotor and adapted, in use, to induce axial fluid flow in a downward direction so as to supplement flow induced in the tank by the primary rotor; and
connecting means for connecting the auxiliary agitation blade to the drive shaft for conjoined rotation with the primary rotor.
2. An agitator according to claim 1, wherein the auxiliary agitation blade defines an angle of incidence that is substantially constant along the length of the blade, as in an axial impeller.
3. An agitator according to claim 2, wherein the angle of incidence is between 15 degrees and around 75 degrees with respect to the direction of travel of the blade.
4. An agitator according to claim 1, wherein the auxiliary agitation blade defines an angle of incidence that varies along the length of the blade, as in a propeller.
5. An agitator according to claim 1, wherein the pitch of the blade is adjustable depending on specific system parameters, such as slurry density, slurry viscosity or flow characteristics within the tank.
6. An agitator according to any one of the preceding claims, wherein the blade includes a substantially straight leading edge.
7. An agitator according to any one of claims 1 to 5, wherein the leading edge of the blade is curved.
8. An agitator according to any one of the preceding claims, wherein the blade is releasably connected to the shaft to allow its position relative to the primary rotor to be adjusted.
9. An agitator according to any one of the preceding claims, wherein, in use, the blade is connected to the shaft at around a midheight of the tank.
10. An agitator according to any one of the preceding claims, wherein the connecting means include a clamp.
11. An agitator according to claim 10, wherein the clamp is formed of two inter-engageable clamping halves.
12. An agitator according to claim 11, wherein the two clamping halves are substantially identical.

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13. An agitator according to any one of claims 10 to 12, wherein inner walls of the clamp together define a generally cylindrical clamping surface.
14. An agitator according to any one of claims 1 to 9, wherein the connecting means take the form of welds or bolts.
15. An agitator according to any one of the preceding claims, including a resilient protective layer coating its exterior surfaces.
16. An agitator according to claim 15, wherein the protective layer is greater than around 3mm thick.
17. An agitator according to claim 14 or claim 15, wherein the protective layer is between around 5mm and around 7mm thick.
18. An agitator according to any one of the preceding claims, including a pair of the auxiliary blades, in use extending radially outwardly from diametrically opposite sides of the shaft, each blade having associated connecting means.
19. An agitator according to any one of claims 1 to 18, including at least three of the blades, in use equally spaced around the perimeter of the shaft, each blade having associated connecting means.
20. An agitator according to claim 18 or claim 19, wherein, in use, each blade intersects the shaft at an angle of incidence of around 45 degrees.
21. Agitation means for a flotation device of the type having a tank, a primary agitator including a primary rotor, drive means, and a drive shaft disposed intermediate the drive means and the primary rotor, said agitation means including:
 - a drive shaft;
 - a primary rotor adapted to induce radial fluid flow and connected to one end of the drive shaft to form the primary agitator; and
 - an auxiliary agitator as defined in any one of claims 1 to 20.
22. Agitation means according to claim 21, wherein the auxiliary agitation blade is releasably connected to the shaft to allow its position relative to the primary rotor to be adjusted.
23. Agitation means according to claim 21 or claim 22, being adapted for use in a three phase environment including water, solids and air.
24. A flotation device including:
 - a tank for containing slurry incorporating minerals to be extracted;
 - a feed inlet for admission of slurry into the tank;

agitation means, as defined in any one of claims 21 to 23, to agitate the slurry within the tank; and

aeration means to aerate the slurry whereby floatable minerals in suspension form a surface froth.

25. A flotation device according to claim 24, including a stator surrounding the rotor.
26. A flotation device according to claim 24 or claim 25, including a peripheral overflow launder extending around the inside top of the tank for recovering mineral enriched froth from the surface.
27. A flotation device according to any one of claims 24 to 26, wherein the aeration means include an air blower and a fluid conduit for directing air from the blower into the rotor.
28. A flotation device according to claim 27, wherein the conduit includes an axial bore extending through the drive shaft.
29. A flotation device according to claim 27 or claim 28, wherein the conduit is disposed to direct air into the rotor from underneath.
30. A flotation device according to any one of claims 24 to 29, including a froth deflection cone extending around the drive shaft adjacent the top of the tank, the smallest diameter of the cone being at its lowermost end nearest the rotor.
31. A flotation device according to claim 30, wherein the deflection cone is disposed to deflect froth outwardly toward the overflow launder as it migrates toward the surface of the tank.
32. A flotation device according to claim 30 or claim 31, wherein the deflection cone is disposed to prevent vortexing at the tank surface.
34. A flotation device according to any one of claims 30 to 32, wherein the auxiliary agitator is located substantially midway between the top of the rotor and the bottom of the deflection cone.
35. A flotation device according to any one of claims 30 to 34, including a reagent addition tube extending downwardly into the tank through the deflection cone.
36. An auxiliary agitator as defined in any one of the preceding claims, adapted for agitating a slurry containing up to around 55% solids.
37. An auxiliary agitator as defined in any one of the preceding claims, adapted for use in a flotation device having a tank with a capacity of at least 50m³.

[AMENDED PAGE]

38. An auxiliary agitator as defined in any one of the preceding claims, wherein the auxiliary agitation blade, in use, acts as an axial impeller to supplement an axial flow induced in the tank by the primary rotor.

39. An auxiliary agitator as defined in claim 37, wherein said axial impeller has a diameter of around 15% to around 35% of the tank diameter.